Umetco Minerals Corporation

INTERNAL CORRESPONDENCE

PO BOX 579 4625 ROYAL AVENUE • NIAGARA FALLS NEW YORK 14302

To (Name) Mr. D. G. Mi lenbruch
Umetco Minerals Corporation
Division Danbury, CT

Location

Area

Copy to Messrs:
R. G. Beverly/R.Jones
L. G. Evans
T. J. Kagetsu
F. V. McMillen
W. D. Smith

Date April 15, 1986

Originating Dept TECHNOLOGY

Area

Answering Letter Date

Subject Niagara Plant Radioactive Material License 950-0139

The purpose of this letter is to bring you up-to-date on four areas within the Niagara Plant that were found to have levels of radioactivity well above background.

For your convenience, I am appending my letter of March 25, 1986 to Mr. R. F. Kelly of the New York State Department of Labor which identifies the four areas and outlines a plan for decontamination.

Subsequently it became obvious that the magnitude of the task was far greater than originally assumed.

In cleaning up the area around No. 30 furnace we filled seventeen 55-gallon drums. We had Mr. William Smith, Radiation Officer for Linde, and acting radiation officer for the Niagara Plant take samples and check them for alpha and alpha beta gamma radiation in his lab at Tonawanada. The activity suggested the cleanup was not complete.

The radiation in Building 24 (V-Al) came from a 9'6" x 10' concrete pit that was filled with a black sand that we later identified as primarily illmenite. This pit seemed endless; we discontinued the operation after removing one hundred twenty six 55-gallon drums and reaching a depth of 9 feet. In addition, the pit was found to extend beneath the floor of the V-Al operation.

The third area, which we assumed was contaminated soil beneath a slag pile turned out to be radiation from the slag itself. The amount of radioactive slag is small in comparison to the thousands of tons piled in the yard and fortunately is confined to a small area. So far we have not determined just how much slag we are talking about but I suspect it is not more than 100 tons. Even this amount presents problems in packaging for disposal

The extent of the contamination in Area 4 which is on L-Tec leased property is unknown at this time. The gamma radiation increases from 200 μR/hr at the surface to about 600 μR/hr at a depth of one foot.

To help in the assessment of our problem, ten (10) samples were submitted to EDA Laboratories in Colorado for radium, uranium and thorium analyses. The sample identification and results are reported in the attached Table 1. Before commenting on the analyses, I draw your attention to the State of New York, Department of Labor, Industrial Code Rule 38 that specifies what is required to terminate a license. Section 38.11, 38.29, Table 5 and Table 2 which pertain to this are reproduced and included as Appendix One.

Briefly, to terminate a license the Commissioner of the Department of Labor has to be notified; all radioactive material must be shipped to an approved recipient; the premises must be decontaminated and surveyed to show decontamination took place; and the survey must be verified by the State. Source material (uranium and thorium) must be reduced to 0.05 percent by weight to meet decontamination. (This is 500 ppm or 500 μg/g.) For non-source material for which we are not licensed, the levels are specific for each element e.g. for radium the exempt concentration is 0.1 pico currie per gram

Returning to Table 1, it can be seen that none of the samples exceed 500 ppm of uranium (results reported in μg/g). 500 ppm of Thorium 232 would have an activity of 55 pCi/g (or each pCi represents about 9ppm). Thus it can be seen there are several samples that contain thorium in excess of that required for decontamination. Looking at samples from each of the areas:

L-Tec, Samples 40-1, 40-2

The sample taken at one foot depth is out of compliance. We have made no attempt to determine the amount of soil that is contaminated.

Slag Pile East of No. 6 Furnace Room, Samples 40-3, 40-4

The Thorium 230 which is in the Uranium 238 decay chain is very high and obviously not in equilibrium with uranium or Radium 226. The Laboratory also found peaks in their analyses that suggest the presence of Thorium 229 (does not occur naturally). This suggests to me that some radioactive material may have been unknowingly introduced into one or more of the vanadium furnace heats and all or part ended up in the slag. This falls into the category of non-licensed material and possibly we need a ruling on it.

Furnace No. 30, Samples 40-5, 41-1, 41-2, 41-3

Sample 40-5 is a sample of slag taken from the south of Furnace 30 before we attempted to clean the area. As we suspected it was high in thorium which was present in the pyrochlor ores used in this furnace to make nickel columbium and ferro-columbium.

Sample 41-1 tells us we have more cleanup to do around the north furnace support. This is a difficult job because access to the support is restricted and also because the slag has penetrated between some of the brick supports.

TABLE 1

RADIOCHEMICAL ANALYSES OF SAMPLES FROM THE NIAGARA PLANT

BY: EDA LABORATORIES - WHEATRIDGE, COLORADO

APRIL 10, 1986

		ANALYSES					
				Thorium			
Sample No.	Description	Ra 226 pCi/g	Uranium µg/g	232 pCi/g	230 pCi/g	228 pCi/g	(229)* (pCi/g)
2446-40-1	Surface Sample - L-Tec Property	14±2	34.7	36±3	15±2	38±3	
2446-40-2	Sample for 1' Deep - L-Tec Property	33±3	33.8	74±4	25±2	74±4	
2446-40-3	Dark Slag - East of No. 6 Furnace Building	4.4±1.1	20.2	16±2	299±7	4.0±.9	17±2
2446-40-4	Light Slag - East of No. 6 Furnace Building	7.0±1.4	18.6	37±3	466±9	14±2	40±3
2446-40-5	Slag Before Digging - South of No. 30 Furnace	550±10	389	241±7	186±6	241±7	
2446-40-6	Sample from Top of Pit - Building No. 24, V-A1	19±2	28.9	16±2	12±2	17±2	
2446-40-7	Sample from Approximate 5' Depth - Building No. 24, V-A1	31±3	44.3	37±3	22±2	39±3	
2446-41-1	Sample from North Furnace Support - Furnace No. 30 After Cleanup	180±10	122	139±5	76±4	145±5	
2446-41-2	Sample from Ground in Front of Furnace No. 30 After Cleanup	42±3	68.4	35±3	19±2	35±3	
2446-41-3	Sample from Southwest Area of Furnace No. 30 After Cleanup	43±3	24 9	9.6±1 3 8.5±1.3	6.2±1.1 5.9±1.0	9.5±1.3 9.2±1.3**	

*Th229 (not positively identified)
**Duplicate Analyses

Samples 41-2 and 41-3 indicate the soil to the front and rear of the furnace contains less than 500 ppm combined uranium and thorium and as such meets requirements for uncontrolled access.

Pit in Building No. 24 (V-A1), Samples 40-6, 40-7

The material removed from the pit in Building 24 analyses less than 500 ppm combined uranium and thorium. However gamma radiation next to a drum will read 150 µR/hr. I believe we will need a ruling on whether we have to dispose of it in an authorized repository or can leave it in the yard The pit is still not completely clean with radiation of about 50 µR/hr above the pit and about 150 µR/hr. at the surface 9 feet down. Background is about 9µR/hr.

I have made the assumption that Radium 226, a decay product of Uranium 238, is at levels consistent with the uranium present and would not be out of line with the 500 ppm source material allowed by New York State. Lee Evans does not agree with me and suspects the state will retreat to the NRC guidelines for unrestricted use. I have mailed Bob Beverly as copy of the New York State Industrial Code Rule 38 for his interpretation.

We are faced with the decision on how to proceed. (1)Umetco could elect not to proceed with license termination but then would be responsible for periodic license renewal, inspections, proof of financial responsibility, etc. and would be unable to sell the property, (2)Umetco could apply to have the license amended so that the area leased to Elkem, hopefully satisfactorily decontaminated, could be excluded from the license, or (3) Umetco could decide to push for license termination. If the third option is selected we will have to better define the problem and spell out the decontamination procedure in far more detail than in my letter of March 25, 1986 to R. F. Kelly.

Hopefully we can tackle this on your planned visit next week.

Sincerely,

D. J. Hansen

mau/357h
Attachments

Umetco Minerals Corporation

PO BOX 579 4625 ROYAL AVENUE • NIAGARA FALLS, NEW YORK 14302

March 25, 1986

Mr. Robert F. Kelly, Senior Radiologist
Occupational Safety & Health
State of New York - Department of Labor
65 Court Street
Buffalo, NY 14202

Subject: Termination of Radioactive Materials License 950-0139

Dear Mr. Kelly:

On March 20, when you obtained soil samples to verify the cleanup of the property behind Building 166 on Elkem leased property, I informed you that we had discovered additional areas within the Niagara Plant that had above background radiation. The purpose of this letter is to document our conversation and to make certain that we take the steps necessary for the termination of License No. 950-0139.

An environmental audit of the Niagara Plant was scheduled in conjunction with the leverage buy out of Umetco's vanadium and tungsten businesses. In preparation for this, Al Gonas and I completed a gamma survey of the various buildings and grounds on the Niagara site. We found four areas with radiation significantly above background In addition, the radioactivity of a number of samples stored in quart sized cans was confirmed.

The location of the radioactivity and the levels of radiation observed are shown in Table I.

TABLE I

AREAS IN NIAGARA PLANT SIGNIFICANTLY ABOVE BACKGROUND

Date Surveyed	Location	Background	Maximum Reading	Times Background
2/12/86	Bldg. 29 (#6 Fce. Rm)	5-10 µR/hr.		
	- I-beam south of 30 Fce.		200 µR/hr.	20
	- Trunion support north of 30 Fce.		420 µR/hr.	42
2/18/86	Bldg. 24 (V-Al)	8-13 µR/hr.		
	- Area below dust collector		170 µR/hr.	15
2/20/86	Yard East of #6 Fce. Rm.	8-12 µR/hr.		
	- 6' x 6' Areas near slag pile		200 µR/hr.	20
2/20/86	Yard East of #6 Fce. Rm.			
	- 2' x 2' area near Bldg. 191		210 µR/hr	20

The surveys were completed with a Ludlum Model 19 Micro R Meter calibrated on September 26, 1984. (Accuracy checked by comparison with an alpha, beta, gamma meter - Nuclear Chicago Model 2650 - March 21, 1986).

The dates the buildings of the Niagara Plant were surveyed and the background radiation observed are contained in Table II. More detailed information is contained in Laboratory Notebook 2446.

TABLE II

RADIATION SURVEY OF NIAGARA PLANT
Ludlum Model 19 - Micro R Meter

Date	Buildings	Background	Comments
2/12/86	29, 30, 77 (Fce. Rm. #6)	5-10 µR/hr.	Area next to Fce. 30 above background
2/14/86	25, 71, (UCAR, GLOBAR)	8-10 µR/hr.	Some sample cans >1mR/hr.
	32 (#2 Packing)	8-10 µR/hr.	OK
2/14/86	89, 89A (#10 Packing)	8-10 µR/hr.	OK
2/18/86	24, 87 (Vanadium Aluminum)	8-13 µR/hr.	Area below Dust Coll. above background
2/20/86	(Storage Shed N.W. Corner of Umetco Property)	8-12 µR/hr.	OK
2/25/86	7 (Storeroom)	8-10 µR/hr.	OK
2/25/86	6 (Maintenance Office, Electrical & Carpenter Shops)	8-10 µR/hr.	OK
2/25/86	82, 82A (Machine Shop, Sheet Metal)	8-10 µR/hr.	OK
2/27/861	13, 14 (Aux. Storeroom, Drum Shop, #8 Packing)	10-12 µR/hr.	OK
3/14/86	111 (Eng. Annex-Works Lab)	15-17 µR/hr.	OK
3/14/86	3 (Compressor Bldg.)	7-8 µR/hr.	OK

The plan for decontamination that I reviewed with you was as follows:

1. Remove and store the contaminated material in suitable containers.

2. Sample the areas, (either soil or surface wipes depending on which applies) and submit them to a qualified laboratory to identify the sources of the radiation and to confirm the radioactivity has been lowered to acceptable levels.

3. Transport the contaminated material together with the radioactive samples from Building 25 to an approved burial site under the supervision of a qualified broker.

4. Provide the Department of Labor with the analytical results and documentation that the material has been removed from the site and has been accepted for burial.

5. Make arrangements for the Department of Labor to obtain samples to verify that the decontamination was satisfactory.

At the time of your visit we had begun to cleanup the area in the vicinity of Furnace No. 30 (contaminated slag and soil were being placed into 55-gallon drums). This has been completed and we are now working on cleaning up the area in Building 24.

I would like to draw to your attention that the last amendment to License 950-0139 that I have on record is listed as No. 9, dated March 1979, expiration date November 1981. However, I have a copy of a letter dated November 17, 1984 which requests transfer of License 950-0139 from Union Carbide to Umetco Minerals addressed to Mr. George Kasyk of the New York Department of Labor. I expect that with our continuing efforts to terminate the license, issuance of the amendments is not a high priority.

If you need more information please contact me. If I do not hear from you I will proceed according to the plan outlined above.

Very truly yours,

D. J. Hansen

mau/349h

cc: Messrs:
M. K. Jackson
F. V. McMillen
R. L. Miller
D. G. Millenbruch
R. C. Smith
R. G. Tisch
C. T. Wentzel

APPENDIX ONE

EXCERPTS FROM INDUSTRIAL CODE RULE 38, STATE OF NEW YORK, DEPARTMENT OF LABOR

[38 11]

38 11 Duration of licenses. Except as below provided, a license shall expire at the end of the expiration date therein stated The filing of an application by the licensee more than 30 days prior to the expiration date for a renewal or a new and superseding license shall extend the license until the commissioner has finally acted on the application If a licensee fails to renew his license, he must immediately cease all use of radioactive materials, transfer all radioactive material to authorized recipient(s) and comply with the requirements of Section 38 29 of this Part (rule) To terminate a license, licensee must notify commissioner, transfer all radioactive materials to authorized recipient(s) and comply with the provisions of Section 38 29 of this Part (rule)

38.12 Renewal of licenses An application for a renewal of a license shall be made on a form prescribed by the commissioner Renewal of a license may be denied on any of the grounds specified in this Part (rule) for the issuance of licenses or for the suspension or revocation of licenses Notwithstanding the renewal of a license, the commissioner may suspend or revoke a license for cause or violations occurring during the license period immediately preceding the issuance of the renewal

38.13 Amendment of licenses. A corrective amendment of a license may be made by the commissioner at any time upon his initiative or at the request of the licensee Upon the licensee's written request the commissioner may amend a license in any respect consistent with this Part (rule) Every license may be amended by the commissioner upon any ground for which he might deny, suspend or revoke such license

38.14 Suspension or revocation. The Commissioner may revoke or suspend any license, or approval, in whole or in part, for

(a) Any material misstatement in the qpplication therefor or in any supplementary statement thereto,

(b) Any condition revealed by such application, supplementary statement, report, record, inspection or other means which would warrant the commissioner to refuse to grant a license or approval on an original application, or

(c) Any violation or failure to observe any of the applicable terms or provisions of a license, an approval, the Labor Law, this Part (rule) or any other applicable law, rule, regulation, code or order

38 15 Additional requirements. Notwithstanding any exemption set forth in this Part (rule), the commissioner may by order, as part of a license or otherwise, make such specific requirements, in addition to those set forth in this Part (rule), as may be reasonably appropriate

timers shall be maintained in good repair and proper operating condition and shall be checked at least every six months or at such intervals as may be required by the commissioner

38.27 Enclosed controlled areas. Any enclosed controlled area with any access opening large enough for the passage of any person shall have such opening provided with an exit door which can be opened manually from the inside or by such other means approved by the commissioner

38.28 Eating, drinking or smoking No person shall permit eating, drinking or smoking in any airborne radioactivity area or in any controlled area with surface contamination above the limits specified in Table 5 of this Part (rule)

38 29 Vacating installations and property. (a) *Installations* Each licensee before vacating any installation, or transferring the premises containing such installation, shall permanently decontaminate such installation and premises below or equal to the limits specified in Table 5 of this Part (rule) A survey shall be made after such decontamination and the commissioner and landlord or subsequent tenant or transferee shall be provided with a copy of such survey No such installation or premises shall be vacated, sold or transferred until the decontamination survey has been verified and accepted by the commissioner

(b) *Property* No machinery, instruments, laboratory equipment or any other property used in contact with or in close proximity to radioactive material in a licensed installation shall be assigned, sold, leased or transferred to an unlicensed person unless such property has been permanently decontaminated below or equal to the limits specified in Table 5 of this Part (rule) A survey shall be made after such decontamination and the commissioner and subsequent transferree or owner shall be provided with a copy of such survey No such property shall be assigned, sold, leased or transferred until such decontamination survey has been verified and accepted by the commissioner

38 30 Personnel monitoring equipment Every person who possesses a radiation source shall apply appropriate calibrated and operable personnel monitoring equipment to, and in case of film badge and thermoluminescent dosimeters which are processed by a laboratory or firm which is currently accredited by the United States National Bureau Standards under their National Voluntary Laboratory Accreditation Program, and shall require the use of such equipment by, each individual whom such person suffers or permits to enter

TABLE 5
LIMITS FOR UNCONTROLLED AREAS

(a) Surface contamination limits			
(1) Alpha emitters			
(i) Removable	15 pCi / 100 cm²	= 33 dpm / 100 cm²	average over any one surface
	45 pCi / 100 cm²	= 100 dpm / 100 cm²	maximum
(ii) Total (fixed)	450 pCi / 100 cm²	= 1000 dpm / 100 cm²	average over any one surface
	2250 pCi / 100 cm²	= 5000 dpm / 100 cm²	maximum
	0 25 mrem at 1 cm / hr		
(2) Beta-Gamma emitters			
(i) Removable (all beta-gamma emitters except Hydrogen 3)	100 pCi / 100 cm²		average over any one surface
	500 pCi / 100 cm²		maximum
Removable (Hydrogen 3)	1000 pCi / 100 cm²		average over any one surface
	5000 pCi / 100 cm²		maximum
(ii) Total (fixed)	0 2		surface

(b) Concentrations in air and water Table 6, Schedule II

(c) Concentrations in soil and other materials except water

(1) Radioactive material except source material Table 2, Column 2

(2) Source material 0 05 per cent by weight

Note Jurisdictional limits The limits listed in Table 5 of this Part (rule) shall apply to those installations and property that remain subject to the jurisdiction of the Labor Law and this Part (rule)

TABLE 2
EXEMPT CONCENTRATIONS

Element (atomic number)	*Isotope*	*Column 1 Gas concentration μCi/ml**	*Column 2 Liquid and solid concentration μCi/ml***
Antimony (51)	Sb 122		3×10^{-4}
	Sb 124		2×10^{-4}
	Sb 125		1×10^{-3}
Argon (18)	A 37	1×10^{-3}	
	A 41	4×10^{-7}	
Arsenic (33)	As 73		5×10^{-3}
	As 74		5×10^{-4}
	As 76		2×10^{-4}
	As 77		8×10^{-4}
Barium (56)	Ba 131		2×10^{-3}
	Ba 140		3×10^{-4}
Beryllium (4)	Be 7		2×10^{-2}
Bismuth (83)	Bi 206		4×10^{-4}
Bromine (35)	Br 82	4×10^{-7}	3×10^{-3}
Cadmium (48)	Cd 109		2×10^{-3}
	Cd 115m		3×10^{-4}
	Cd 115		3×10^{-4}
Calcium (20)	Ca 45		9×10^{-5}
	Ca 47		5×10^{-4}
Carbon (6)	C 14	1×10^{-6}	8×10^{-3}
Cerium (58)	Ce 141		9×10^{-4}
	Ce 143		4×10^{-4}
	Ce 144		1×10^{-4}
Cesium (55)	Cs 131		2×10^{-2}
	Cs 134m		6×10^{-2}
	Cs 134		9×10^{-5}
	Cs 137		2×10^{-4}
Chlorine (17)	Cl 38	9×10^{-7}	4×10^{-3}
Chromium (24)	Cr 51		2×10^{-2}
Cobalt (27)	Co 57		5×10^{-3}
	Co 58		1×10^{-3}
	Co 60		5×10^{-4}
Copper (29)	Cu 64		3×10^{-3}
Dysprosium (66)	Dy 165		4×10^{-3}
	Dy 166		4×10^{-4}
Erbium (68)	Er 169		9×10^{-4}
	Er 171		1×10^{-3}

See notes at end of table

TABLE 2—(Continued)
EXEMPT CONCENTRATIONS

Element (atomic number)	*Isotope*	*Column 1 Gas concentration μCi/ml**	*Column 2 Liquid and solid concentration μCi/ml***
Europium (63)	Eu 152 (T ½ = 9 2 Hrs)		6×10^{-4}
	Eu 155		2×10^{-3}
Fluorine (9)	F 18	2×10^{-6}	8×10^{-3}
Gadolinium (64)	Gd 153		2×10^{-3}
	Gd 159		8×10^{-4}
Gallium (31)	Ga 72		4×10^{-4}
Germanium (32)	Ge 71		2×10^{-2}
Gold (79)	Au 196		2×10^{-3}
	Au 198		5×10^{-4}
	Au 199		2×10^{-3}
Hafnium (72)	Hf 181		7×10^{-4}
Hydrogen (1)	H 3	5×10^{-6}	3×10^{-2}
Indium (49)	In 113m		1×10^{-2}
	In 114m		2×10^{-4}
Iodine (53)	I 126	3×10^{-9}	2×10^{-5}
	I 131	3×10^{-9}	2×10^{-5}
	I 132	8×10^{-8}	6×10^{-4}
	I 133	1×10^{-8}	7×10^{-5}
	I 134	2×10^{-7}	1×10^{-3}
Iridium (77)	Ir 190		2×10^{-3}
	Ir 192		4×10^{-4}
	Ir 194		3×10^{-4}
Iron (26)	Fe 55		8×10^{-3}
	Fe 59		6×10^{-4}
Krypton (36)	Kr 85m	1×10^{-6}	
	Kr 85	3×10^{-6}	
Lanthanum (57)	La 140		2×10^{-4}
Lead (82)	Pb 203		4×10^{-3}
Lutetium (71)	Lu 177		1×10^{-3}
Manganese (25)	Mn 52		3×10^{-4}
	Mn 54		1×10^{-3}
	Mn 56		1×10^{-3}
Mercury (80)	Hg 197m		2×10^{-3}
	Hg 197		3×10^{-3}
	Hg 203		2×10^{-4}

See notes at end of table

TABLE 2—(Continued)
EXEMPT CONCENTRATIONS

Element (atomic number)	*Isotope*	*Column 1 Gas concentration μCi/ml**	*Column 2 Liquid and solid concentration μCi/ml***
Molybdenum (42)	Mo 99		2×10^{-3}
Neodymium (60)	Nd 147		6×10^{-4}
	Nd 149		3×10^{-3}
Nickel (28)	Ni 65		1×10^{-3}
Niobium (Columbium)(41)	Nb 95		1×10^{-3}
	Nb 97		9×10^{-3}
Osmium (76)	Os 185		7×10^{-4}
	Os 191m		3×10^{-2}
	Os 191		2×10^{-3}
	Os 193		6×10^{-4}
Palladium (46)	Pd 103		3×10^{-3}
	Pd 109		9×10^{-4}
Phosphorus (32)	P 32		2×10^{-4}
Platinum (78)	Pt 191		1×10^{-3}
	Pt 193m		1×10^{-2}
	Pt 197m		1×10^{-2}
	Pt 197		1×10^{-3}
Polonium (84)	Po 210	2×10^{-10}	7×10^{-6}
Potassium (19)	K 42		3×10^{-3}
Praseodymium (59)	Pr 142		3×10^{-4}
	Pr 143		5×10^{-4}
Promethium (61)	Pm 147		2×10^{-3}
	Pm 149		4×10^{-4}
Radium (88)	Ra 226	1×10^{-11}	1×10^{-7}
	Ra 228	2×10^{-11}	3×10^{-7}
Rhenium (75)	Re 183		6×10^{-3}
	Re 186		9×10^{-4}
	Re 188		6×10^{-4}
Rhodium (45)	Rh 103m		1×10^{-1}
	Rh 105		1×10^{-3}
Rubidium (37)	Rb 86		7×10^{-4}
Ruthenium (44)	Ru 97		4×10^{-3}
	Ru 103		8×10^{-4}
	Ru 105		1×10^{-3}
	Ru 106		1×10^{-4}
Samarium (62)	Sm 153		8×10^{-4}

See notes at end of table

TABLE 2—(Continued)
EXEMPT CONCENTRATIONS

Element (atomic number)	*Isotope*	*Column 1 Gas concentration μCi/ml**	*Column 2 Liquid and solid concentration μCi/ml***
Scandium (21)	Sc 46		4×10^{-4}
	Sc 47		9×10^{-4}
	Sc 48		3×10^{-4}
Selenium (34)	Se 75		3×10^{-3}
Silicon (14)	Si 31		9×10^{-3}
Silver (47)	Ag 105		1×10^{-3}
	Ag 110m		3×10^{-4}
	Ag 111		4×10^{-4}
Sodium (11)	Na 24		2×10^{-3}
Strontium (38)	Sr 85		1×10^{-3}
	Sr 89		1×10^{-4}
	Sr 91		7×10^{-4}
	Sr 92		7×10^{-4}
Sulfur (16)	S 35	9×10^{-8}	6×10^{-4}
Tantalum (73)	Ta 182		4×10^{-4}
Technetium (43)	Tc 96m		1×10^{-1}
	Tc 96		1×10^{-3}
Tellurium (52)	Te 125m		2×10^{-3}
	Te 127m		6×10^{-4}
	[illegible]		3×10^{-3}
			3×10^{-4}
			6×10^{-4}
	Te 132		3×10^{-4}
Terbium (65)	Tb 160		4×10^{-4}
Thallium (81)	Tl 200		4×10^{-3}
	Tl 201		3×10^{-3}
	Tl 202		1×10^{-3}
	Tl 204		1×10^{-3}
Thulium (69)	Tm 170		5×10^{-4}
	Tm 171		5×10^{-3}
Tin (50)	Sn 113		9×10^{-4}
	Sn 125		2×10^{-4}
Tungsten (Wolfram) (74)	W 181		4×10^{-3}
	W 187		7×10^{-4}
Vanadium (23)	V 48		3×10^{-4}
Xenon (54)	Xe 131m	4×10^{-6}	
	Xe 133	3×10^{-6}	
	Xe 135	1×10^{-6}	

See notes at end of table

TABLE 2—(Continued)
EXEMPT CONCENTRATIONS

Element (atomic number)	*Isotope*	*Column 1 Gas concentration μCi/ml**	*Column 2 Liquid and solid concentration μCi/ml***
Ytterbium (70)	Yb 175		1×10^{-3}
Yttrium (39)	Y 90		2×10^{-4}
	Y 91m		3×10^{-2}
	Y 91		3×10^{-4}
	Y 92		6×10^{-4}
	Y 93		3×10^{-4}
Zinc (30)	Zn 65		1×10^{-3}
	Zn 69m		7×10^{-4}
	Zn 69		2×10^{-2}
Zirconium (40)	Zr 95		6×10^{-4}
	Ar 97		2×10^{-4}
Alpha-emitting radioactive material other than special nuclear and transuranic material not listed above		1×10^{-12}	1×10^{-8}
Beta and/or gamma-emitting radioactive material not listed above with half-life less than 3 years .		1×10^{-10}	1×10^{-6}

NOTES

* Values are given for those materials normally used as gases

** μc/gm for solids

Note 1 Many radionuclides disintegrate into daughter products which are also radioactive In expressing the concentrations in Table 2, the activity stated is that of the parent radionuclide and takes into account the daughter products

Note 2 For the purposes of section 38 41, Table 1, Exemption 2 of this Part (rule) where there is present a combination of radionuclides, the limit for the combination shall be derived as follows

(a) Determine for each radionuclide present the following quotient Set the numerator equal to the concentration of the radionuclide present and the denominator equal to the exempt concentration listed in Table 2 The sum of such quotients shall not exceed "one"

Example

$$\frac{\text{Concentration of Radionuclide A present}}{\text{Exempt concentration of Radionuclide A}} + \frac{\text{Concentration of Radionuclide B present}}{\text{Exempt concentration of Radionuclide B}} + \leq 1$$